NASA TECHNICAL TRANSLATION NASA TT F-14,512

TEMPERATURE OF GRASSY AND ROLLED SOILS

Z. H. Varga

Translation of "A füves és a hengerezett talaj hömérséklete," Idojaras, Vol. 67, No. 3, Budapest, May-June 1963, pp. 178-179.

(NASA-TT-F-14512) TEMPERATURE OF GRASSY AND ROLLED SOILS Z.H. Varga (Translation Consultants, Ltd.) Aug. 1972 5 p CSCL 08M

N72-30339

Unclas
G3/13 38554

RECEIVED SEP 1972 NASA STI FACILITY INPUT BRANCH

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WASHINGTON, D. C. 20546 AUGUST 1972

TEMPERATURE OF GRASSY AND ROLLED SOILS

Z. H. Varga

ABSTRACT: From the agricultural point of view it is important to know whether or not the soil temperature of meteorological stations located in grassy areas is essentially different from that of cultivated soils. A new method is suggested for the investigation of this question. The author has divided into two parts the measurement data obtained in 24 hours: those taken during the period of irradiation and those registered during the time of radiation. To these two sets of data he applied a nonparametric method referring to samples containing a small number of elements. His new method can be used to solve other meteorological problems.

Since the soil around some of our weather stations is grassy, we made a 24- /178* hour study to see if there is any significant difference between grassy soil and cultivated soil temperatures. This question is of primary concern to agricultural meteorological information.

We shall discuss the problem on the basis of data measured earlier (5-6 July 1957) and described in a previous article [1]. Here, we will study the temperatures measured at a depth of 2 cm in grassy and rolled soils, but our results would be similar for different cultivated soils, as well as for measurements at 5 cm and 10 cm depths.

With reference to the results described in the above-mentioned article, we immediately divided the 24-hour data into an irradiation period and a radiation period. We considered the irradiation period so that when the heat flux in the 2 cm-5 cm layer was directed into the soil, and the radiation period as that when the heat was emanating from the surface. Let us first examine the irradiation period. Experience has taught us that rolled soil is warmer in the daytime than grassy soil, but the question is how much warmer.

We used a quick method [2], one suitable for the examination of samples composed of a few units, to answer the question. This method can be used on many meteorological problems, so we shall show, in brief, not only the result,

---

* Numbers in the margin indicate pagination in the foreign text.

but the entire procedure as well.

Use of the method depends on three conditions:

1. the examined statistical population must be continuous;
2. the samples for comparison must be independent of each other;
3. the samples to be compared must have identical numbers of units.

Its great advantage is that the distribution must not be normal, and this is why it can often be used in meteorology as well. In our case all three conditions were satisfied.

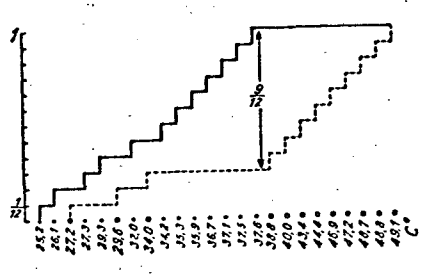
The first step in the evaluation is to arrange the measurement data by magnitude in both samples, then form a single series, by magnitude, from the two series:

25.2	*32,0*	*37.1*	44.4
26,1	34,0	*37,5*	46.9
27,2	*34,2*	*37,6*	47,2
27,3	*35,3*	38,8	48.7
29,3	*35,9*	40,0	48,8
29,6	*36,7*	43,4	49,1

The italicized data are the temperatures of the grassy soil, the non-italicized those for rolled soil. Let us now lay out our system of coordinates on graph paper and plot the combined series data at equal distances from the origin on the x-axis. Grassy soil data are plotted by dots, those for rolled soil by small circles (Figure 1). The y-axis is marked off to match the number of samples. Here n = 12. Each graduation is equal to 1/n, so the maximum graduation will be 1. Now, we can chart the graphs. Let us start with the ⁹ /179 grassy soil. Starting at the origin of the coordinate system, we move up one graduation when we come to a dot on the x-axis until we reach "1" on the scale. We thus obtain a step graph which we call the empirical sample distribution graph. We chart the other graph similarly.

We designate the peak of the grassy soil temperature graph above the graph of the rolled soil by D^+ and the peak of the rolled soil graph above the graph of the grassy soil by D^-. In our case $D^+ = b/n = 9/12$, and $D^- = a/n = 0$, expressed in y-axis units. We then use the table (the preliminary hypothesis case!) [3] to find the value of b in the n = 12 column for a = 0 at the 99.9%

level. If this is smaller than the calculated value of b, or equal to it, the deviation is significant. Our sample shows this as well, that is, the grassy soil of the meteorological station is much cooler at noon than the rolled soil, or in general, than cultivated soils. This must definitely be considered in surveys and reports on soil temperature.



Reproduced from best available copy.

Figure 1. Empirical distribution graphs of 2 cm temperature of grassy and the rolled soil during the irradiation period on 5 July 1957.

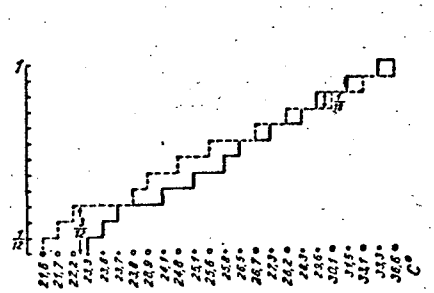


Figure 2. Empirical distribution graph of 2 cm temperature of grassy and the rolled soil during the radiation period on 5-6 July 1957.

Now let us examine the radiation period (Figure 2). Our procedure is identical with that used before, but we cannot reach any conclusions from term observations of temperature conditions at night, and since we have no similar, earlier, investigations, we use the table without a preliminary hypothesis. The deviation is not significant, even at the 95% level. Accordingly, there is no significant difference between the soil temperatures read during the radiation period, so when morning observations are made of radiation, conclusions also can be drawn on the basis of a grassy meterological station for temperatures of cultivated soils.

Investigations in this field also made it evident that [1] if one is interested in the temperature differences in two soils, it is sufficient to take the readings during the irradiation period because radiation generally produces no significant differences in soil temperatures. These findings refer chiefly to summer months.

Manuscript received
25 September 1962

REFERENCES

1. Kozma, F., Varga, Z. H., "Daily Course of the Temperature of Cultivated and Covered Soils," Idojaras, 62, 1958, p. 150.

2. Juvancz, I., Liptak, T., "Some Problems of the Biomedical Application of Mathematical Statistics," Közlemenyek [Applied Mathematics Institute, Hungarian Academy of Sciences], Vol. 1, 1952, p. 175.

3. Supplement to the above article, Ibid, Vol. 2, 1953, p. 239.

Translated for the National Aeronautics and Space Administration under contract no. NASw-2038 by Translation Consultants, Ltd., 944 South Wakefield Street, Arlington, Virginia 22204.